

without any mention of the magnetic units of the C.G.S. system, leading the reader to conclude that the volt is equal to 10^8 of the static C.G.S. units. These are grave errors in a book designed for specialists. On p. 94 the author, or editor, announces the insertion of some "data given . . . by physicists known for their veracity." Are there any others?

OUR BOOK SHELF

Key to Magnus's Class-Book of Hydrostatics and Pneumatics. (London Science Class-Books.) By John Murphy. 67 pp. (London: Longmans, Green, and Co., 1885.)

MR. MURPHY has rendered useful service to science teachers by the publication of the solutions of the exercises and problems given in Mr. Magnus's widely-known volume. These problems cover the whole ground of elementary hydrostatics and pneumatics; and the solutions are intelligently worked out in full. The work has had the benefit of Mr. Magnus's own revision; and this should be a guarantee of the goodness of the methods followed and of the correctness of the results. The only fault we have to notice is a tendency to looseness in the use of certain terms about which there ought not in physical science to be the slightest vagueness: we refer to the misuse of the words *strain* and *pressure* where the proper word should be *force*. A strain is an alteration of shape or volume, and ought not to be confused with the force which produces the strain. A pressure is a force divided by an area and cannot be specified except by naming both the force and the area on which that force acts. Yet on p. 5 of Mr. Murphy's Key occurs the statement that "the pressure or whole strain to which the sphere is subjected equals the weight . . . of the liquid." It is greatly to be desired that this ambiguity between pressure and force should as speedily as possible be removed from this and all other elementary books, as it is misleading to beginners as well as incorrect.

Electrical Units. By Dr. R. Wormell, M.A. (London: T. Murby, no date.)

THIS little work of 48 pp. is apparently issued as an appendix to the author's class-book of "Electricity and Magnetism." It contains a concise and easy account of the units in ordinary use, and of the notion of dimensions of units so puzzling to beginners. A number of useful data of constants are given, and there are some numerical problems for calculation added. Dr. Wormell's genius as a teacher comes out in several points: the transition from magnetic to electro-magnetic units being particularly neatly brought about on p. 10. A few slips should be corrected at once. In the table on p. 1 the electro-chemical equivalent of hydrogen is given as '00001055, and on p. 14 as '0000105. According to the late results of Kohlrausch and Lord Rayleigh it is '00001035. On p. 6 the horse-power is wrongly stated as 746 kilogrammetres per second. On p. 15 there is a curious muddle about units of capacity, arising partly from a confusion between electrostatic and electromagnetic units. It is certainly *not* true that a sphere of one centimetre radius has a capacity about equal to that of "the whole Atlantic cable"; neither is the *farad* the millionth part of the *microfarad*. It also must strike the practical electrician as rather a curious statement that (p. 33) the Swan lamp is usually fed by the Gordon dynamo. We were under the impression that only one Gordon dynamo had yet been built, and that it had not been used since last winter. The connections of the Brush armature on p. 37 are wrong; and the author should not describe Edison's armature as being like that of Gramme, when the fact is that it pays royalty to Siemens as a Siemens armature.

Weekly Problem Papers, with Notes, intended for the Use of Students Preparing for Mathematical Scholarships and for the Junior Members of the Universities who are reading for Mathematical Honours. By the Rev. J. J. Milne, M.A. (London: Macmillan, 1885.)

MR. WALTER BESANT in a recent work entitled "In Luck at Last," makes his heroine (a Maria d'Agnesi or a Somerville) remark, "No life can be dull when one is thinking about mathematics all day. Do you study mathematics?" For such a one this handy volume of a hundred papers, each of which has at least seven questions, some of which bifurcate or trifurcate, will be a charming companion. Though the range is limited to the requirements of a University scholarship—this by the way is fairly extended at the present day—yet there is sufficient "variety" in the selection of problems to make it what we state it to be above, "charming." The book, as such a work ought to be, has been printed with very great care, and, after a close perusal, we have detected only two or three slight clerical errors. The compiler, who is to be congratulated on his successful achievement of a somewhat difficult task, proposes to bring out at a future date a second volume containing his solutions to the exercises. Wolstenholme's collection is, except under the guidance of a judicious tutor, too hard and too full of tricks for the class whose wants this manual is designed to meet; the boy who has mastered this collection, or a fraction of it, will have realised what sort of questions he will be called upon to "tackle" when he has an examination paper before him.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

Free Hydrogen in Comets

TOWARDS the end of an admirable mathematical paper on the theory of the forms of comets, received this morning by post from M. Bredichin, that very able Director of the Imperial Observatory of Moscow (specifying himself, to, in English at the head of a pamphlet in the French language as "Associate of the Royal Astronomical Society"), draws the conclusion that the great comet of 1881 was a structure of compound hydrocarbon gas, while Halley's historic comet was "of a type which corresponds to pure hydrogen."

The distinguished author's position with regard to the comet of 1881 I presume will be contested by no one; for all the spectroscopes of the time proved so abundantly that the light of that comet was of the kind familiarly known among technists as "the candle-spectrum," or the spectrum of the compound gas CII, in the form of acetylene, perhaps, but entirely peculiar to carbo-hydrogen. Who, however, can help the theorist of Moskva's white-stoned city and golden domes to establish the probability of a spectrum of pure and elemental hydrogen gas for Halley's comet, before that wanderer in far off space shall return in the beginning of next century, and then instantly testify its chemical composition to the spectrum analysis of that day?

One of the difficulties which M. Bredichin has to deal with meanwhile, seems to be, that no trace of a pure hydrogen spectrum has ever yet been seen in any comet, however much of CH there may have been; and he is driven to suggest that the H₁ or hydrogen lines—so entirely different from those of CH—were invisible on account of their faintness. But though that idea, with some modification or explanation, may ultimately turn out to be correct, it requires something more just now to create many converts to it, particularly in face of the universal experience of all dabblers in spectroscopy with vacuum tubes; for they know so well that, whatever the reputed gas in them may be, intrusive lines of hydrogen, though present as an un-

avoidable impurity only, are usually the most incisive and brilliant part of the display.

In a paper, however, on "Micrometrical Measures of Gaseous Spectra," kindly printed, but not yet published, for me by the Royal Society, Edinburgh, there is a full description of a case which will be found to supply exactly the practical details that may strengthen M. Bredichin's views.

After having had tubes, and tubes, and tubes again of CH gas, of various varieties of CH and at various pressures made by different makers, and having found their CH spectrum (under the electrical incandescence which M. Bredichin also assumes for his comets) always more or less imperfect and more and more haunted, often overpowered, by the brilliant lines of pure hydrogen, I followed out the indications of least failure by eventually having made a so-called vacuum, but really four inches of mercury pressure tube of olefant gas. It was constructed for me, with very peculiar attention to, and precautions for, purity, by Mr. Charles F. Casella, of 147, Holborn, and attained absolute success at last, for no trace of any impurity whatever could I discover in it from one end of the spectrum to the other.

Not only so, too, but the spectrum which it did show was the most brilliant and perfect one of CH that I have ever heard of. Every one knows the five diversely coloured bands of CH, four of them first well described by Prof. Swan in 1856; each band beginning towards the red with strong lines and bright haze, which fades off towards the violet side into black, vacant space long before the next band begins. And many persons know that with greater spectroscopic power that haze is capable of being resolved into a system of smaller lines, and far closer, or linelets, but still coming to an end considerably short of where the next band begins.

But on this occasion, with the extra heavy olefant gas-tube, strong induction sparks, and a spectroscope having 24° dispersion from A to H of solar spectrum, a telescopic magnifying power of 14, a very narrow slit and excellent definition of prisms, the linelets, usually so difficult to identify, were as sharp and clear as luminous needles, and continued, in a series of regularly-increasing spaces apart, the whole distance from one CH band to the next. This completeness was distinctly proved, first with the Orange band and its needle-like scale of linelets (after all its strong lines had been left behind), extending up so as to touch, as it were, the brilliant beginning of the Citron band. Then came its bright lines and closely-packed linelets continually widening in distance apart, but losing nothing in sharpness and definition until the Green band was reached. With the Green band was its leader (the so-called "Green Giant of Carbohydrogen") burning like a pillar of electric fire; then its close linelets; then its second line and linelets rather wider apart; its third line and linelets still wider; and onwards linelets wider yet, but preserving admirable regularity of series all the way, all the long way, without missing, or slurring, one step, the whole distance right up to the beginning of the Blue band.

Yet over one part of that lengthy road something extraneous did appear; vaguely at first, or as a mere faint ghost of a barely perceptible roll of gray-coloured cirrostratus cloud! Could it be subjective only? possibly the reflection from a fatigued part of the retina of the observer's eye. Not that, for the linelets of CH were still brilliantly sharp, thin, and narrow everywhere. What then? I, who had condemned scores of vacuum tubes of all the gases for being filled with H lines, had never seen anything like that floating, filmy cloud before!

But thought is quicker than sight. A suspicion of the truth flashed in a moment upon me; and on turning to the Red end of the Spectrum, there, over the known place of Hydrogen's Red line, was another faint broad region of barely visible luminous haze, but reddish, in place of, like the other, a blue-gray. Even, too, as I watched them, from that moment on through an hour, first turning to one and then to the other, those haze-clouds narrowed and narrowed towards their central verticals, whilst the sharp little linelets of the CH *pari passu* became paler and paler, until at last they only remained visible in the neighbourhood of the bigger lines and strong beginnings of their respective bands. And by that time the once faint clouds, the red and the gray, had become transformed into two piercingly bright lines of Hydrogen light, the representatives of Solar C and Solar F; while the carbon of the CH, which the H had been eliminated from by the action of the electric spark, was deposited on the inside of the tube as a brown glaze.

This, then, is the case of independent observation which I beg to hand over to M. Bredichin for discussion, believing it to illustrate that

(1) In the condition most suitable for showing the CH, or ordinary cometic, spectrum,—no H should appear.

(2) If a little free H should be introduced into a full atmosphere of CH, the characteristic lines of H are at first so *extra* broadened—though seen under the same circumstances that those of CH are *ultra* narrow and defined in—as to be weakened thereby below visibility, unless, indeed, the CH spectrum at the time be almost infinitely brighter than it has ever yet been found in any Comet.

(3) The longer the incandescing electric influence is at work, the greater is the evolution of pure H on one side, and deposition of solid C on the other, out of CH gas. Whence we may possess for the future an indicator for the comparative age of Comets; or, at least, may pretty certainly conclude Halley's Comet to be older than that of 1881, if bright, narrow lines of pure H, with or without CH bands accompanying, shall be visible in the spectrum of the former at its next return: that, in itself a consummation long most earnestly wished for, but now more than ever to be desired, to test the penetrating theory of a Russian Astronomer and Mathematician.

C. PIAZZI SMYTH

15, Royal Terrace, Edinburgh, January 19

Iridescent Clouds

ON pp. 148 and 149 of the current volume of NATURE there are two letters describing "iridescent clouds," and the idea is conveyed that this phenomenon is only of late occurrence. That this is hardly justifiable, the following account from a diary will show:—

At Knoxville, Tennessee, on the afternoon of February 16, 1878, after many days of cloud and drizzle—something unusual in that country—the sun being about 10° high and the sky partially covered with large haze-clouds, there was noticed in the south-west, against one of these clouds, a slightly curved band of prismatic colours about 90° in length; which, but for its position in the west, might have been mistaken for a rainbow—concave toward the sun, the sun, however, not at the centre of curvature, and about 30° distant from it. The green was most strongly marked; this shaded off on each side, and on the side of the band next the sun was red; upon the opposite side the colour was less distinct, but there it seemed to be reddish.

Again, during September or October 1882 (this from memory), at the same place, about sunset, with a patched, cloudy sky, the sun not visible, the prismatic colours were noticed in the south-west near a break in the clouds. This time the colours were in the form of an elongated ellipse, with indistinct edges, between 2° and 3° in greatest length.

Then, during the fall of 1883, the prismatic colours were once noticed under similar circumstances to those mentioned here in Virginia.

W. G. BROWN

University of Virginia, Virginia, U.S.A., January 12

The Iridescent Clouds alluded to above

In our northern as well as insular position, with weakened sunshine and an atmosphere always more or less darkened by coal-smoke, we must be prepared to allow much for what is, and is to be, seen of the grander meteors of meteorology in the more southern latitude, clearer air, and intensified climate of the Virginian portion of so great a continent as America. But before any one there can claim to see frequently that very phenomenon of the iridescent clouds, communicated last December to NATURE by various persons, but by myself perhaps as the chief culprit, he must be quite sure, amid the crowd of known and already described parhelia, mock suns, broken rainbows, &c., that what he sees has the same discriminating optical characteristics as those particular clouds now in question; and that any one of his cases was, in America, so unusually brilliant a display of them, and so widespread an instance of it, that from one end of the States to the other it was on the same day similarly seen, wondered at, and declared even by gray-headed old men to be new to them, in at least anything approaching that astonishing degree of splendour and perfection, though by no means new to creation over a longer lapse of time.

The Virginian letter-writer, however, speaks merely of what he himself saw, describes the colours as prismatic, in place of the anti prismatic arrangement witnessed here, and alludes to one case of a curved band "about 90° in length," which contrasts exceedingly with the forms and sizes noted in this country.